US009710092B2

(12) **United States Patent**
Han et al.

(10) **Patent No.: US 9,710,092 B2**
(45) **Date of Patent: Jul. 18, 2017**

(54) **BIOMETRIC INITIATED COMMUNICATION**

(71) Applicant: **Apple Inc.**, Cupertino, CA (US)

(72) Inventors: **Byron B. Han**, Cupertino, CA (US); **Craig A. Marciniak**, San Jose, CA (US); **John A. Wright**, San Francisco, CA (US)

(73) Assignee: **Apple Inc.**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 535 days.

(21) Appl. No.: **13/840,770**

(22) Filed: **Mar. 15, 2013**

(65) **Prior Publication Data**

US 2014/0002388 A1 Jan. 2, 2014

Related U.S. Application Data

(60) Provisional application No. 61/666,769, filed on Jun. 29, 2012.

(51) **Int. Cl.**

G06F 3/0488	(2013.01)
G06F 3/041	(2006.01)
H04M 1/725	(2006.01)
H04M 1/67	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 3/0414*** (2013.01); ***G06F 3/0488*** (2013.01); ***H04M 1/72541*** (2013.01); *H04M 1/67* (2013.01); *H04M 2250/22* (2013.01)

(58) **Field of Classification Search**

CPC G06F 3/0414; G06F 2203/04104; G06F 2203/04105; G06F 3/0488

USPC 345/156, 173, 174; 178/18.01–18.07, 178/19.01–19.05

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,323,846 B1	11/2001	Westerman et al.
6,570,557 B1	5/2003	Westerman et al.
6,677,932 B1	1/2004	Westerman

(Continued)

FOREIGN PATENT DOCUMENTS

CN	102461133	5/2012
EP	2226741	9/2010

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion dated Oct. 24, 2013, PCT/US2013/047830, 11 pages.

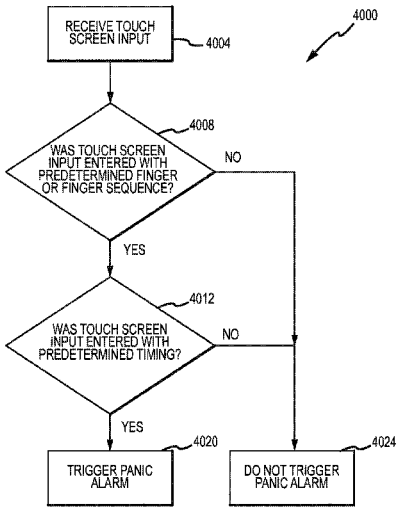
Primary Examiner — Ricardo L Osorio

(74) *Attorney, Agent, or Firm* — Brownstein Hyatt Farber Schreck, LLP

(57) **ABSTRACT**

A device has a touch processing module that processes touch screen input to determine if the manner in which the input was entered indicates that the user intends for execution of a particular command. In one embodiment, the module may acquire fingerprint data from the user's input and analyze the data to determine if the input was entered with a particular finger or finger sequence. In another embodiment, the module may also acquire timing data from the user's entry of a plurality of inputs and analyze the timing data to determine if the touch screen input was entered with a particular timing or cadence. In still another embodiment, the module may also acquire force data from the user's entry of a plurality of touch screen inputs and analyze the force data to determine to determine if the touch screen input was entered with a particular force.

19 Claims, 5 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

6,888,536	B2	5/2005	Westerman et al.	
7,697,729	B2	4/2010	Howell et al.	
8,023,700	B2	9/2011	Riionheimo	
9,235,733	B2	1/2016	Birdwell et al.	
2008/0030301	A1*	2/2008	Terao	340/5.53
2008/0267465	A1*	10/2008	Matsuo et al.	382/126
2010/0158328	A1*	6/2010	Lee	382/124
2010/0192096	A1*	7/2010	Barrett	715/811
2011/0078771	A1	3/2011	Griffin	
2011/0319051	A1	12/2011	Reitnour	
2012/0154296	A1*	6/2012	Hinckley et al.	345/173
2013/0173925	A1*	7/2013	Yen et al.	713/186

FOREIGN PATENT DOCUMENTS

EP	2230623	9/2010
WO	WO 2010/107827	9/2010

* cited by examiner

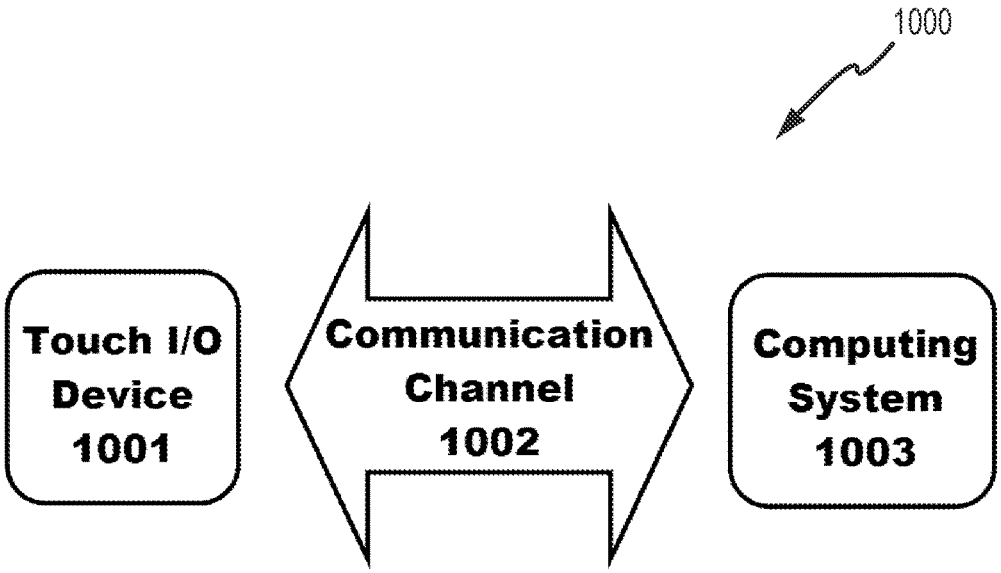

1000
Touch I/O Device 1001
Communication Channel 1002
Computing System 1003

FIG.1

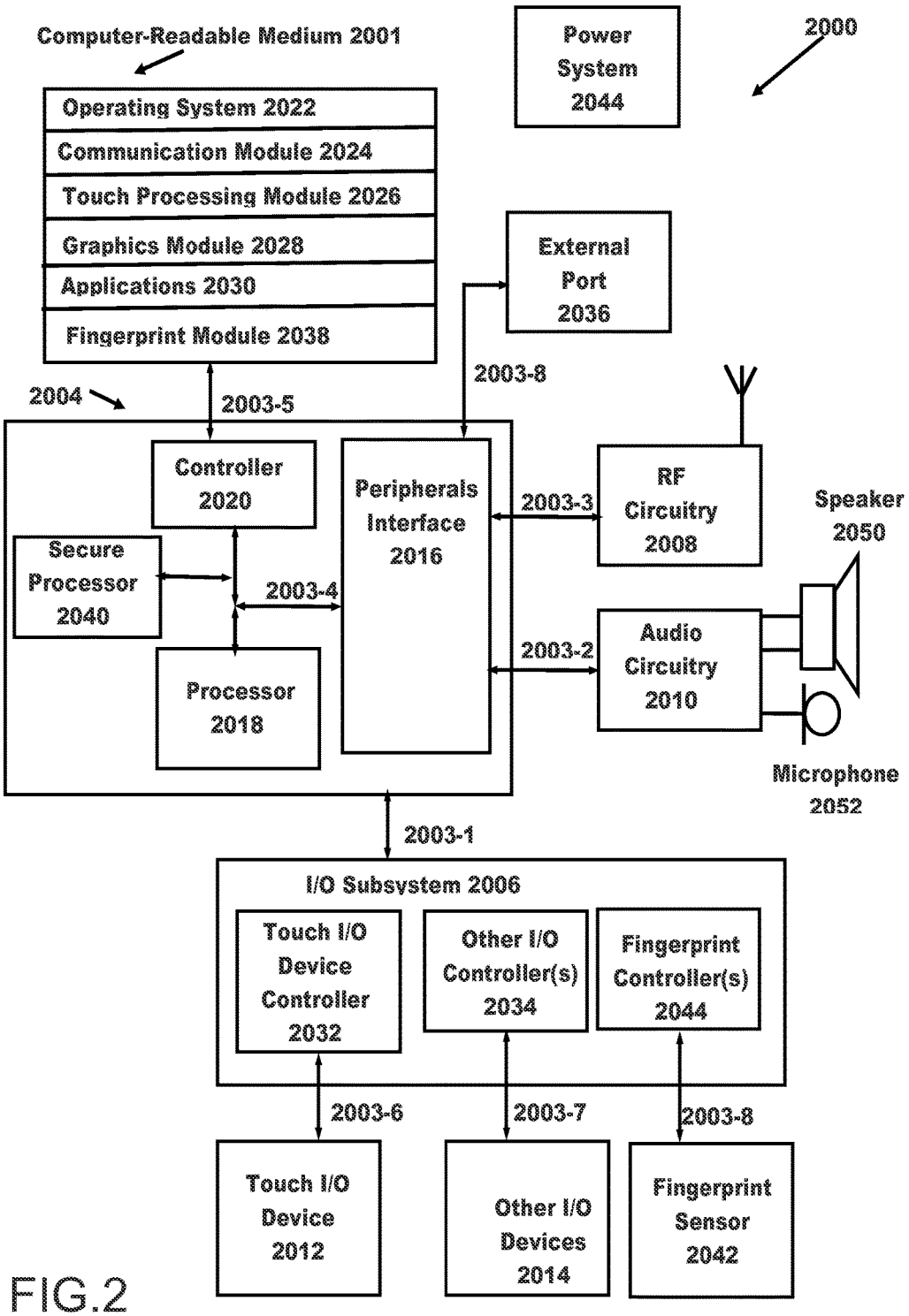

Computer-Readable Medium 2001
Power System 2044
2000
Operating System 2022
Communication Module 2024
Touch Processing Module 2026
Graphics Module 2028
Applications 2030
Fingerprint Module 2038
External Port 2036
2003-8
2004
2003-5
Controller 2020
Peripherals Interface 2016
2003-3
RF Circuitry 2008
Speaker 2050
Secure Processor 2040
2003-4
2003-2
Audio Circuitry 2010
Processor 2018
Microphone 2052
2003-1
I/O Subsystem 2006
Touch I/O Device Controller 2032
Other I/O Controller(s) 2034
Fingerprint Controller(s) 2044
2003-6
2003-7
2003-8
Touch I/O Device 2012
Other I/O Devices 2014
Fingerprint Sensor 2042

FIG.2

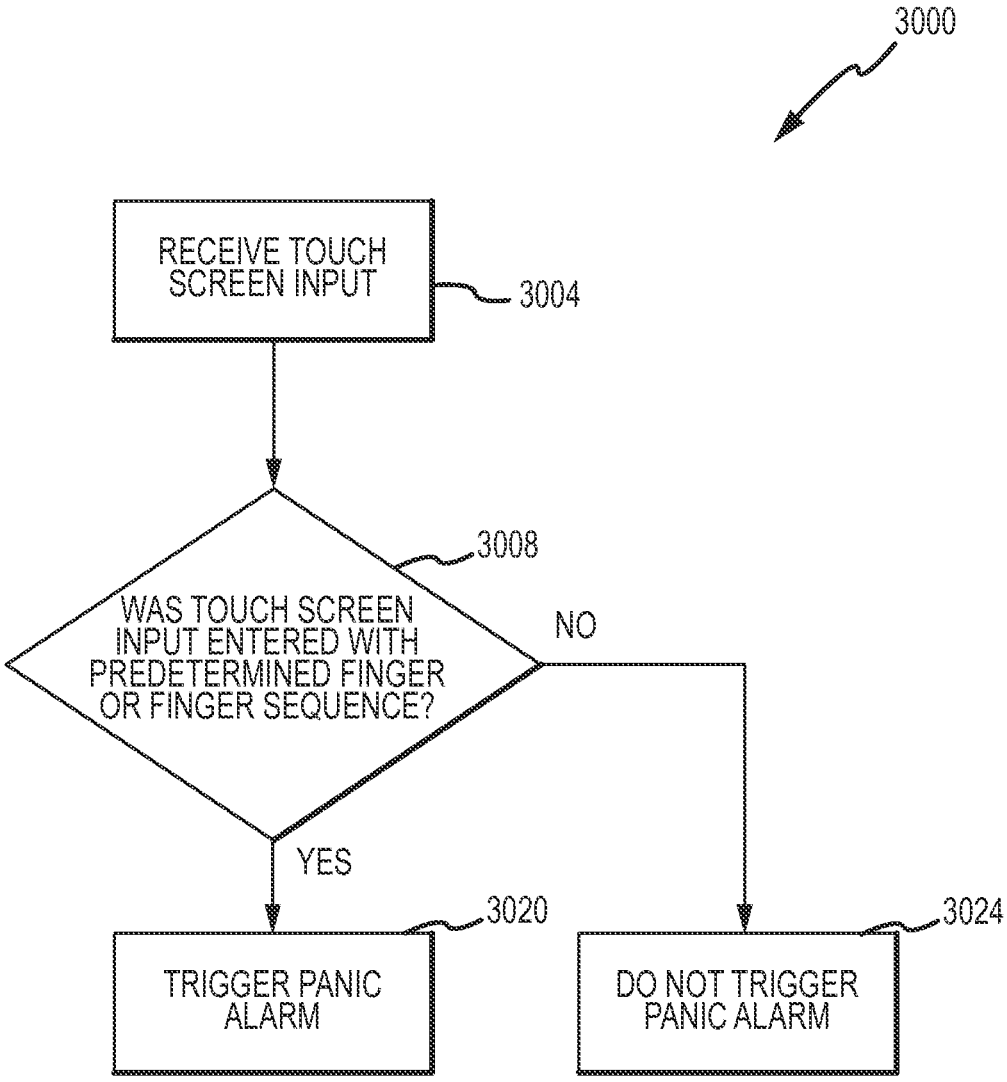

3000
RECEIVE TOUCH SCREEN INPUT
3004
3008
WAS TOUCH SCREEN INPUT ENTERED WITH PREDETERMINED FINGER OR FINGER SEQUENCE?
NO
YES
3020
TRIGGER PANIC ALARM
3024
DO NOT TRIGGER PANIC ALARM

FIG.3

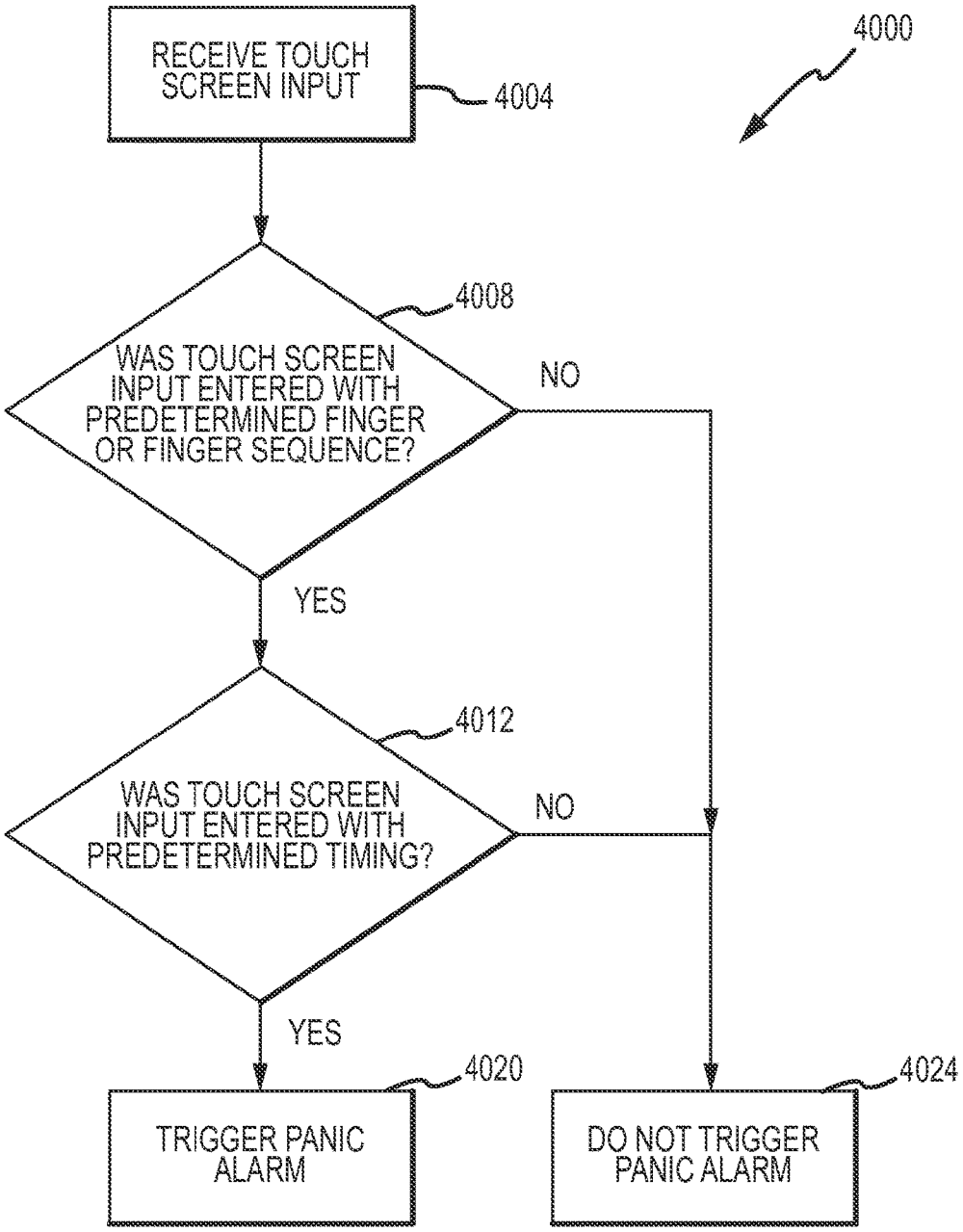

4000
RECEIVE TOUCH SCREEN INPUT
4004
4008
WAS TOUCH SCREEN INPUT ENTERED WITH PREDETERMINED FINGER OR FINGER SEQUENCE?
NO
YES
4012
WAS TOUCH SCREEN INPUT ENTERED WITH PREDETERMINED TIMING?
NO
YES
4020
TRIGGER PANIC ALARM
4024
DO NOT TRIGGER PANIC ALARM

FIG.4

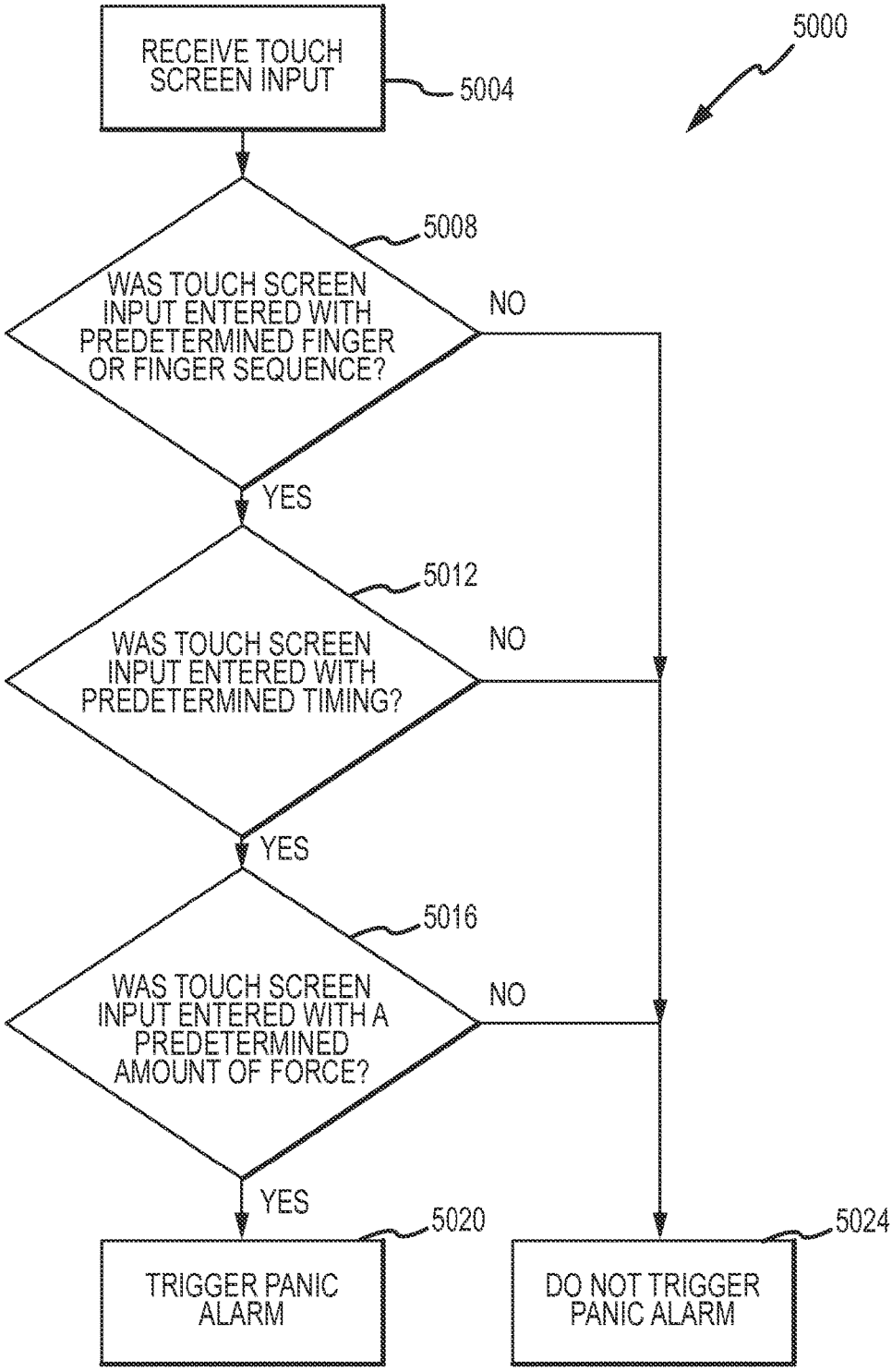

5000
RECEIVE TOUCH SCREEN INPUT
5004
5008
WAS TOUCH SCREEN INPUT ENTERED WITH PREDETERMINED FINGER OR FINGER SEQUENCE?
NO
YES
5012
WAS TOUCH SCREEN INPUT ENTERED WITH PREDETERMINED TIMING?
NO
YES
5016
WAS TOUCH SCREEN INPUT ENTERED WITH A PREDETERMINED AMOUNT OF FORCE?
NO
YES
5020
TRIGGER PANIC ALARM
5024
DO NOT TRIGGER PANIC ALARM

FIG.5

BIOMETRIC INITIATED COMMUNICATION

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims the benefit under 35 U.S.C. §119(e) to U.S. Provisional Patent Application No. 61/666,769, which was filed on Jun. 29, 2012, and entitled "Biometric Initiated Communication," which is incorporated by reference as if fully disclosed herein.

TECHNICAL FIELD

The present invention relates generally to electronic devices, and more specifically to electronic devices that execute commands in response to receipt of biometric or other information indicating certain predetermined commands.

BACKGROUND

Electronic devices, such as mobile or cellular phones, may be equipped with functionality for contacting emergency services in an expedited manner. For example, a mobile phone may prominently display instructions for contacting "911" or other emergency services in a way that by-passes password entry or log-in screens. However, when a user utilizes a mobile phone to contact emergency services in this way, that fact that he is doing so can be readily apparent to someone watching his actions. Thus, in a situation where the device owner is forced to unlock or otherwise use his phone by an assailant, contacting emergency services in the conventional manner may not be practical. Accordingly, in conventional systems, a user is unable to comply with an assailant's commands, while at the same time discreetly contacting emergency services.

SUMMARY

Examples of embodiments described herein may take the form of an electronic device having a touch processing module that processes touch screen input to determine if the manner in which the touch screen input was entered indicates that the user intends for the electronic device to execute a particular command.

In one embodiment, the touch processing module acquires fingerprint data from the user's entry of touch screen input, and analyzes the fingerprint data to determine if the touch screen input was entered with a particular finger or finger sequence that the user has predetermined to indicate a particular command.

In another embodiment, the touch processing module may also acquire timing data from the user's entry of a plurality of touch screen inputs, and analyze the timing data to determine if the touch screen input was entered with a particular timing or cadence that the user has predetermined to indicate a particular command.

In still another embodiment, the touch processing module may also acquire force data from the user's entry of a plurality of touch screen inputs, and analyze the force data to determine to determine if the touch screen input was entered with a particular force that the user has predetermined to indicate a particular command.

In accordance with various example embodiments described herein, a electronic device may execute a particular command if the manner in which touch screen input was entered indicates that the user intends for the electronic device to execute the particular command. The electronic device may execute the particular command discreetly so that no indication of the execution is apparent. The electronic device may also execute the particular command concurrently with a command that is explicitly indicated by the touch screen input. In one embodiment, the manner in which touch screen input was entered indicates a panic command to which the electronic device responds by calling emergency services and providing geographic location information and/or streaming audio or video from the electronic device. In another embodiment, the manner in which touch screen input was entered indicates a macro command that includes a series of commands that when executed together execute the macro command.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic illustration of a electronic device embodiment that includes a touch screen device provided in association with a computing system;

FIG. **2** is a schematic illustration of system architecture for the electronic device shown in FIG. **1**;

FIG. **3** is a flow chart illustrating a first method of processing touch input in an electronic device to extract commands to be executed by the electronic device;

FIG. **4** is a flow chart illustrating a second method of processing touch input in an electronic device to extract commands to be executed by the electronic device; and

FIG. **5** is a flow chart illustrating a third method of processing touch input in an electronic device to extract commands to be executed by the electronic device.

SPECIFICATION

This disclosure relates generally to an electronic device having a touch processing module that processes touch screen input to determine if the manner in which the touch screen input was entered indicates that the user intends for the electronic device to execute a particular command. In making such a determination, various electronic device embodiments use fingerprint data, timing data, and/or force data that is acquired from the user as the user enters a touch screen input. An electronic device in accordance with embodiments discussed herein may execute a particular command if the user enters touch screen input in a manner that indicates that the user intends for the electronic device to execute the particular command. Such a command may differ from the explicit command that is specified by the touch screen input itself. By executing a command in this way, the electronic device is able to execute a command discreetly so that no indication of the execution is apparent.

Embodiments described herein may be configured to operate with a variety of sensors, including strip or swipe sensors, array or other two-dimensional sensors, and the like. FIG. **1** is a schematic illustration of an electronic device **1000** in accordance with embodiments discussed herein. As shown in FIG. **1**, an electronic device **1000** embodiment may include touch I/O device **1001** that can receive touch input for interacting with computing system **1003** via wired or wireless communication channel **1002**. Touch I/O device **1001** may be used to provide user input to computing system **1003** in lieu of or in combination with other input devices such as a keyboard, mouse, etc. One or more touch I/O devices **1001** may be used for providing user input to computing system **1003**. Touch I/O device **1001** may be an integral part of computing system **1003** (e.g., touch screen on a laptop) or may be separate from computing system

1003. In various embodiments described herein, the computing system 1003 may be operable to acquire a fingerprint from a finger that is used to enter inputs through the touch I/O device 1001. The computing system 1003 may also be operable to acquire timing and/or force information associated with inputs that are entered through the touch I/O device 1001.

Touch I/O device 1001 may include a touch sensitive panel which is wholly or partially transparent, semitransparent, non-transparent, opaque or any combination thereof. Touch I/O device 1001 may be embodied as a touch screen, touch pad, a touch screen functioning as a touch pad (e.g., a touch screen replacing the touchpad of a laptop), a touch screen or touchpad combined or incorporated with any other input device (e.g., a touch screen or touchpad disposed on a keyboard) or any multi-dimensional object having a touch sensitive surface for receiving touch input.

In one example, touch I/O device 1001 embodied as a touch screen may include a transparent and/or semitransparent touch sensitive panel partially or wholly positioned over at least a portion of a display. According to this embodiment, touch I/O device 1001 functions to display graphical data transmitted from computing system 1003 (and/or another source) and also functions to receive user input. In other embodiments, touch I/O device 1001 may be embodied as an integrated touch screen where touch sensitive components/devices are integral with display components/devices. In still other embodiments a touch screen may be used as a supplemental or additional display screen for displaying supplemental or the same graphical data as a primary display and to receive touch input.

Touch I/O device 1001 may be configured to detect the location of one or more touches or near touches on device 1001 based on capacitive, resistive, optical, acoustic, inductive, mechanical, chemical measurements, or any phenomena that can be measured with respect to the occurrences of the one or more touches or near touches in proximity to deice 1001. Software, hardware, firmware or any combination thereof may be used to process the measurements of the detected touches to identify and track one or more gestures. A gesture may correspond to stationary or non-stationary, single or multiple, touches or near touches on touch I/O device 1001. A gesture may be performed by moving one or more fingers or other objects in a particular manner on touch I/O device 1001 such as tapping, pressing, rocking, scrubbing, twisting, changing orientation, pressing with varying pressure and the like at essentially the same time, contiguously, or consecutively. A gesture may be characterized by, but is not limited to a pinching, sliding, swiping, rotating, flexing, dragging, or tapping motion between or with any other finger or fingers. A single gesture may be performed with one or more hands, by one or more users, or any combination thereof.

Computing system 1003 may drive a display with graphical data to display a graphical user interface (GUI). The GUI may be configured to receive touch input via touch I/O device 1001. Embodied as a touch screen, touch I/O device 1001 may display the GUI. Alternatively, the GUI may be displayed on a display separate from touch I/O device 1001. The GUI may include graphical elements displayed at particular locations within the interface. Graphical elements may include but are not limited to a variety of displayed virtual input devices including virtual scroll wheels, a virtual keyboard, virtual knobs, virtual buttons, any virtual UI, and the like. A user may perform gestures at one or more particular locations on touch I/O device 1001 which may be associated with the graphical elements of the GUI. In other embodiments, the user may perform gestures at one or more locations that are independent of the locations of graphical elements of the GUI. Gestures performed on touch I/O device 1001 may directly or indirectly manipulate, control, modify, move, actuate, initiate or generally affect graphical elements such as cursors, icons, media files, lists, text, all or portions of images, or the like within the GUI. For instance, in the case of a touch screen, a user may directly interact with a graphical element by performing a gesture over the graphical element on the touch screen. Alternatively, a touch pad generally provides indirect interaction. Gestures may also affect non-displayed GUI elements (e.g., causing user interfaces to appear) or may affect other actions within computing system 1003 (e.g., affect a state or mode of a GUI, application, or operating system). Gestures may or may not be performed on touch I/O device 1001 in conjunction with a displayed cursor. For instance, in the case in which gestures are performed on a touchpad, a cursor (or pointer) may be displayed on a display screen or touch screen and the cursor may be controlled via touch input on the touchpad to interact with graphical objects on the display screen. In other embodiments in which gestures are performed directly on a touch screen, a user may interact directly with objects on the touch screen, with or without a cursor or pointer being displayed on the touch screen.

Feedback may be provided to the user via communication channel 1002 in response to or based on the touch or near touches on touch I/O device 1001. Feedback may be transmitted optically, mechanically, electrically, olfactory, acoustically, or the like or any combination thereof and in a variable or non-variable manner.

Attention is now directed towards embodiments of a system architecture that may be embodied within any portable or non-portable device including but not limited to a communication device (e.g. mobile phone, smart phone), a multi-media device (e.g., MP3 player, TV, radio), a portable or handheld computer (e.g., tablet, netbook, laptop), a desktop computer, an All-In-One desktop, a peripheral device, or any other system or device adaptable to the inclusion of system architecture 2000, including combinations of two or more of these types of devices. FIG. 2 is a block diagram of one embodiment of system 2000 that generally includes one or more computer-readable mediums 2001, processing system 2004, Input/Output (I/O) subsystem 2006, radio frequency (RF) circuitry 2008 and audio circuitry 2010. These components may be coupled by one or more communication buses or signal lines 2003. Each such bus or signal line may be denoted in the form 2003-X, where X is a unique number. The bus or signal line may carry data of the appropriate type between components; each bus or signal line may differ from other buses/lines, but may perform generally similar operations.

It should be apparent that the architecture shown in FIG. 2 is only one example architecture of system 2000, and that system 2000 could have more or fewer components than shown, or a different configuration of components. The various components shown in FIG. 2 can be implemented in hardware, software, firmware or any combination thereof, including one or more signal processing and/or application specific integrated circuits.

RF circuitry 2008 is used to send and receive information over a wireless link or network to one or more other devices and includes well-known circuitry for performing this function. RF circuitry 2008 and audio circuitry 2010 are coupled to processing system 2004 via peripherals interface 2016. Interface 2016 includes various known components for establishing and maintaining communication between

peripherals and processing system **2004**. Audio circuitry **2010** is coupled to audio speaker **2050** and microphone **2052** and includes known circuitry for processing voice signals received from interface **2016** to enable a user to communicate in real-time with other users. In some embodiments, audio circuitry **2010** includes a headphone jack (not shown).

Peripherals interface **2016** couples the input and output peripherals of the system to processor **2018** and computer-readable medium **2001**. One or more processors **2018** communicate with one or more computer-readable mediums **2001** via controller **2020**. Computer-readable medium **2001** can be any device or medium that can store code and/or data for use by one or more processors **2018**. Medium **2001** can include a memory hierarchy, including but not limited to cache, main memory and secondary memory. The memory hierarchy can be implemented using any combination of RAM (e.g., SRAM, DRAM, DDRAM), ROM, FLASH, magnetic and/or optical storage devices, such as disk drives, magnetic tape, CDs (compact disks) and DVDs (digital video discs). Medium **2001** may also include a transmission medium for carrying information-bearing signals indicative of computer instructions or data (with or without a carrier wave upon which the signals are modulated). For example, the transmission medium may include a communications network, including but not limited to the Internet (also referred to as the World Wide Web), intranet(s), Local Area Networks (LANs), Wide Local Area Networks (WLANs), Storage Area Networks (SANs), Metropolitan Area Networks (MAN) and the like.

One or more processors **2018** run various software components stored in medium **2001** to perform various functions for system **2000**. In some embodiments, the software components include operating system **2022**, communication module (or set of instructions) **2024**, touch processing module (or set of instructions) **2026**, graphics module (or set of instructions) **2028**, one or more applications (or set of instructions) **2030**, and fingerprint sensing module (or set of instructions) **2038**. Each of these modules and above noted applications correspond to a set of instructions for performing one or more functions described above and the methods described in this application (e.g., the computer-implemented methods and other information processing methods described herein). These modules (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules may be combined or otherwise rearranged in various embodiments. In some embodiments, medium **2001** may store a subset of the modules and data structures identified above. Furthermore, medium **2001** may store additional modules and data structures not described above.

Operating system **2022** includes various procedures, sets of instructions, software components and/or drivers for controlling and managing general system tasks (e.g., memory management, storage device control, power management, etc.) and facilitates communication between various hardware and software components.

Communication module **2024** facilitates communication with other devices over one or more external ports **2036** or via RF circuitry **2008** and includes various software components for handling data received from RF circuitry **2008** and/or external port **2036**.

Graphics module **2028** includes various known software components for rendering, animating and displaying graphical objects on a display surface. In embodiments in which touch I/O device **2012** is a touch sensitive display (e.g., touch screen), graphics module **2028** includes components for rendering, displaying, and animating objects on the touch sensitive display.

One or more applications **2030** can include any applications installed on system **2000**, including without limitation, a browser, address book, contact list, email, instant messaging, word processing, keyboard emulation, widgets, JAVA-enabled applications, encryption, digital rights management, voice recognition, voice replication, location determination capability (such as that provided by the global positioning system (GPS)), a music player, etc.

Touch processing module **2026** includes various software components for performing various tasks associated with touch I/O device **2012** including but not limited to receiving and processing touch input received from I/O device **2012** via touch I/O device controller **2032**. The touch processing module **2026** may be configured to processes touch screen input to determine if the manner in which the touch screen input was entered indicates that the user intends for the electronic device to execute a particular command. Various aspects of this function of the touch processing module are described herein in connection with FIGS. **3-5**.

System **2000** may further include a fingerprint sensing module **2038** that may at least be executed to perform, or function to perform, various tasks associated with the fingerprint sensor, such as receiving and processing fingerprint sensor input. The fingerprint sensing module **2038** may also control certain operational aspects of the fingerprint sensor **2042**, such as its capture of fingerprint data and/or transmission of the same to the processor **2018** and/or secure processor **2040**. Module **2038** may also interact with the touch I/O device **2012**, graphics module **2028** or other graphical display. Module **2038** may be embodied as hardware, software, firmware, or any combination thereof. Although module **2038** is shown to reside within medium **2001**, all or portions of module **2038** may be embodied within other components within system **2000** or may be wholly embodied as a separate component within system **2000**.

I/O subsystem **2006** is coupled to touch I/O device **2012** and one or more other I/O devices **2014** for controlling or performing various functions. Touch I/O device **2012** communicates with processing system **2004** via touch I/O device controller **2032**, which includes various components for processing user touch input (e.g., scanning hardware). One or more other input controllers **2034** receives/sends electrical signals from/to other I/O devices **2014**. Other I/O devices **2014** may include physical buttons, dials, slider switches, sticks, keyboards, touch pads, additional display screens, or any combination thereof.

If embodied as a touch screen, touch I/O device **2012** displays visual output to the user in a GUI. The visual output may include text, graphics, video, and any combination thereof. Some or all of the visual output may correspond to user-interface objects. Touch I/O device **2012** forms a touch-sensitive surface that accepts touch input from the user. Touch I/O device **2012** and touch screen controller **2032** (along with any associated modules and/or sets of instructions in medium **2001**) detects and tracks touches or near touches (and any movement or release of the touch) on touch I/O device **2012** and converts the detected touch input into interaction with graphical objects, such as one or more user-interface objects. In the case in which device **2012** is embodied as a touch screen, the user can directly interact with graphical objects that are displayed on the touch screen. Alternatively, in the case in which device **2012** is embodied as a touch device other than a touch screen (e.g., a touch

pad), the user may indirectly interact with graphical objects that are displayed on a separate display screen embodied as I/O device **2014**.

Touch I/O device **2012** may be analogous to the multi-touch sensitive surface described in the following U.S. Patents: U.S. Pat. No. 6,323,846 (Westerman et al.), U.S. Pat. No. 6,570,557 (Westerman et al.), and/or U.S. Pat. No. 6,677,932 (Westerman), and/or U.S. Patent Publication 2002/0015024A1, each of which is hereby incorporated by reference.

Embodiments in which touch I/O device **2012** is a touch screen, the touch screen may use LCD (liquid crystal display) technology, LPD (light emitting polymer display) technology, OLED (organic LED), or OEL (organic electro luminescence), although other display technologies may be used in other embodiments.

Feedback may be provided by touch I/O device **2012** based on the user's touch input as well as a state or states of what is being displayed and/or of the computing system. Feedback may be transmitted optically (e.g., light signal or displayed image), mechanically (e.g., haptic feedback, touch feedback, force feedback, or the like), electrically (e.g., electrical stimulation), olfactory, acoustically (e.g., beep or the like), or the like or any combination thereof and in a variable or non-variable manner.

System **2000** also includes power system **2044** for powering the various hardware components and may include a power management system, one or more power sources, a recharging system, a power failure detection circuit, a power converter or inverter, a power status indicator and any other components typically associated with the generation, management and distribution of power in portable devices.

In some embodiments, peripherals interface **2016**, one or more processors **2018**, and memory controller **2020** may be implemented on a single chip, such as processing system **2004**. In some other embodiments, they may be implemented on separate chips.

In addition to the foregoing, the system **2000** may include a secure processor **2040** in communication with a fingerprint sensor **2042**, via a fingerprint I/O controller **2044**. The secure processor **2040** may be implemented as one or more processing units. The secure processor may be implemented as one or more processing units. The operation of these various elements will now be described.

The fingerprint sensor **2042** may operate to capacitively capture a series of images, or nodes. When taken together, these nodes may form a fingerprint. The full set of nodes may be referred to herein as a "mesh." Although the fingerprint sensor is described as operating capactively, it is understood that this is an example. In various implementations, the fingerprint sensor be optical, capacitive, ultrasonic, and/or any other such mechanism for capturing one or more images and one or more portions of one or more fingerprints. It is understood that the embodiments discussed herein may operate with any suitable fingerprint sensor, including swipe or strip sensors, array or other two-dimensional sensors, and so on.

Each node in the mesh may be separately captured by the fingerprint sensor **2042**, which may be an array sensor. Generally, there is some overlap between images in nodes representing adjacent portions of a fingerprint. Such overlap may assist in assembling the fingerprint from the nodes, as various image recognition techniques may be employed to use the overlap to properly identify and/or align adjacent nodes in the mesh.

Sensed fingerprint data may be transmitted through the fingerprint I/O controller **2044** to the processor **2018** and/or the secure processor **2040**. In some embodiments, the data is relayed from the fingerprint I/O controller **2044** to the secure processor **2040** directly. The fingerprint data is encrypted, obfuscated, or otherwise prevented from being accessed by an unauthorized device or element, by any of the fingerprint sensor **2042**, the fingerprint I/O controller **2044** or another element prior to being transmitted to either processor. The secure processor **2040** may decrypt the data to reconstruct the node. In some embodiments, unencrypted data may be transmitted directly to the secure processor **2040** from the fingerprint controller **2044** (or the sensor **2042** if no controller is present). The secure processor may then encrypt this data.

Fingerprint data, either as nodes or meshes, may be stored in the computer-readable medium **2001** and accessed as necessary. In some embodiments, only the secure processor **2040** may access stored fingerprint data, while in other embodiments either the secure processor or the processor **2018** may access such data.

FIG. **3** is a flow chart **3000** illustrating a first touch processing method embodiment. Initially, in operation **3004**, the touch processing module **2026** acquires fingerprint data from touch input that is entered into the electronic device **1000** through a fingerprint sensor. This sensor may be associated with a touch screen, input (e.g., a button or switch), housing, and so on. The sensor may underlie such elements or other be adjacent or proximate thereto. Once the touch processing module **2026** acquires fingerprint data in operation **3004**, control may pass to operation **3008**.

In operation **3008**, touch processing module **2026** analyzes the fingerprint data to determine if the manner in which the touch input was entered indicates that the user intends for the electronic device **1000** to execute a particular command. The touch input may command an otherwise routine operation of the electronic device **1000**, such as entering a number into a keypad to unlock the device. However, the touch input may be entered with a particular finger or sequence of fingers that the user has predetermined to indicate a command to be executed by the electronic device.

The correlation between a particular finger or sequence of fingers may be programmed by the user at an earlier time. For example, the user may program the electronic device to recognize input entered with her pinky finger as a command to place a "911" call or otherwise contact emergency services. In another example, the user may program the electronic device to recognize input entered with a particular sequence of fingers, such as pinky-ring-pinky, as a command to make an emergency call. Thus, regardless of what routine command the user is ostensibly entering, if the user enters the routine command with the predetermined finger or finger sequence, the user is also entering the predetermined command. For example, a user may be ostensibly be unlocking her device, but by doing so with her predetermined "911 finger" she is also calling the police.

In analyzing the fingerprint data, the touch processing module **2026** matches a list of one or more predetermined commands with the acquired fingerprint data. If the touch processing module **2026** discovers that fingerprint data indicates that the user intends for the electronic device to execute a particular command, then control passes to operation **3020**, where the command is executed. If not, then control passes to operation **3024**. In operation **3024**, no predetermined finger or finger sequence command is executed. Nevertheless, any routine command that is indicated by the touch input may be executed in operation **3024**.

FIG. **4** is a flow chart **4000** illustrating a second touch processing method embodiment. In the method illustrated by

flow chart **4000**, a predetermined command is indicated by both fingerprint data and timing data. By analyzing both fingerprint data and timing data, the method illustrated in FIG. **4** has a greater level of entropy that of the method illustrated in FIG. **3**.

Initially, in operation **4004**, the touch processing module **2026** acquires fingerprint data from touch input, as described above in connection with operation **3004**. Additionally, the touch processing module **2026** acquires timing data as the touch input is entered through the touch screen. In one embodiment, the timing data includes time intervals between separate touches that together make-up the touch input. Once the touch processing module **2026** acquires fingerprint data and timing data in operation **4004**, control may pass to operation **4008**.

In operation **4008**, touch processing module **2026** analyzes the fingerprint data to determine if the manner in which the touch input was entered indicates that the user intends for the electronic device to execute a particular command, as described above in connection with operation **3008**. If the touch processing module **2026** discovers that fingerprint data indicates that the user intends for the electronic device to execute a particular command, then control passes to operation **4012**. If not, then control passes to operation **4024**.

In operation **4012**, touch processing module **2026** analyzes the timing data to determine if the manner in which the touch input was entered indicates that the user intends for the electronic device to execute a particular command. Specifically, the touch input may be entered with a particular speed or cadence that the user has been predetermined to indicate a command to be executed by the electronic device. Like the correlations between a finger or a finger sequence and a particular command, the correlations between speed or cadence and a particular command may be programmed by the user at an earlier time.

If the touch processing module **2026** discovers that the timing data indicates that the user intends for the electronic device to execute a particular command, then control passes to operation **4020**, where the command is executed. If not, then control passes to operation **4024**. As described above in connection with operation **3024**, no predetermined command is executed in operation **4024**. Nevertheless, any routine command that is indicated by the touch input may be executed in operation **3024**.

FIG. **5** is a flow chart **5000** illustrating a third touch processing method embodiment. In the method illustrated by flow chart **5000**, a predetermined command is indicated by both fingerprint data and timing data. By analyzing fingerprint data, timing data and force data, the method illustrated in FIG. **5** has a greater level of entropy that of the methods illustrated in FIGS. **3** and **4**.

Initially, in operation **5004**, the touch processing module **2026** acquires fingerprint data and timing data from touch input, as described above in connection with operation **4004**. Additionally, the touch processing module **2026** acquires force data as the touch input is entered through the touch screen. In one embodiment, the forced data indicates an amount of force applied by one or more fingertips of the user against the touch screen as the touch input was entered. Once the touch processing module **2026** acquires fingerprint data, timing data, and force data in operation **5004**, control may pass to operation **5008**.

In operation **5008**, touch processing module **2026** analyzes the fingerprint data to determine if the manner in which the touch input was entered indicates that the user intends for the electronic device to execute a particular command, as described above in connection with operation **3008**. If the touch processing module **2026** discovers that fingerprint data indicates that the user intends for the electronic device to execute a particular command, then control passes to operation **5012**. If not, then control passes to operation **5024**.

In operation **5012**, touch processing module **2026** analyzes the timing data to determine if the manner in which the touch input was entered indicates that the user intends for the electronic device to execute a particular command, as described above in connection with operation **4012**. If the touch processing module **2026** discovers that the timing data indicates that the user intends for the electronic device to execute a particular command, then control passes to operation **5016**. If not, then control passes to operation **5024**.

In operation **5016**, touch processing module **2026** analyzes the force data to determine if the manner in which the touch input was entered indicates that the user intends for the electronic device to execute a particular command. Specifically, the touch input may be entered with a particular force that the user has been predetermined to indicate a command to be executed by the electronic device. Like the correlations between a finger or a finger sequence and a particular command, the correlations between force and a particular command may be programmed by the user at an earlier time.

If the touch processing module **2026** discovers that the force data indicates that the user intends for the electronic device to execute a particular command, then control passes to operation **5020**, where the command is executed. If not, then control passes to operation **5024**. As described above in connection with operation **3024**, no predetermined command is executed in operation **5024**. Nevertheless, any routine command that is indicated by the touch input may be executed in operation **5024**.

In one implementation of the methods described herein, the user predetermines that the command indicated by a particular finger or sequence of fingers is a stealth command to be executed by the electronic without any apparent indication that the stealth command is being executed. The user could use this command to call emergency services without that fact being known to an assailant or other aggressive person that prompted the emergency call. In this way, the electronic device **1000** implements a "panic command" that may include, for example, transmitting the geographic location of the electronic device, and/or transmitting streaming audio or video from the phone. Additionally, a "panic command" may cause the electronic device **1000** to erase or hide certain data or applications from the memory of the electronic device **1000**. In this way, sensitive data such as social security numbers and the like are erased so that they cannot be discovered by a perpetrator who steals the electronic device **1000**.

In another implementation of the methods described herein, the user predetermines that the command indicated by a particular finger or sequence of fingers is a macro command that includes a series of commands that when executed together execute the macro command.

CONCLUSION

The foregoing description has broad application. Accordingly, the discussion of any embodiment is meant only to be an example and is not intended to suggest that the scope of the disclosure, including the claims, is limited to these examples.

What is claimed is:

1. A method of executing a command in an electronic device, comprising:

receiving touch input through a touch screen component of an electronic device;

acquiring fingerprint data from one or more fingertips of the user that are used to enter the touch input through the touch screen;

analyzing the fingerprint data to determine if the touch input was entered with a particular sequence of fingers that the user has predetermined to indicate a command to be executed by the electronic device; and

if a predetermined command is indicated by the fingerprint data, executing the command, wherein the touch input comprises a sequence of individual touch inputs separated apart in time, the method further comprising: acquiring timing data as the touch input is entered through the touch screen, the timing data comprising time intervals between the individual touches; analyzing the fingerprint data in combination with the timing data to determine if the touch input was entered with a particular finger or sequence of fingers and with a particular timing sequence that the user has predetermined to indicate a command to be executed by the electronic device; and if a predetermined command is indicated by the fingerprint data and the timing data, executing the command.

2. The method of claim **1**, wherein if a predetermined command is not indicated by the fingerprint data, the method further comprising:

executing any command that is explicitly indicated by the touch input.

3. The method of claim **1**, wherein the touch input conveys an explicit command to be executed by the electronic device, and the user has predetermined that the command indicated by the particular sequence of fingers is a stealth command to be executed by the electronic device without any apparent indication that the stealth command is being executed, the method further comprising:

executing the explicit command; and

while the explicit command is executing, executing the stealth command without outputting an indication that the stealth command is executing.

4. The method of claim **3**, wherein the stealth command is a panic command and the operation of executing the panic command includes sending a communication to emergency services.

5. The method of claim **4**, wherein the communication to emergency services includes transmitting the geographic location of the electronic device.

6. The method of claim **4**, wherein the communication to emergency services includes transmitting streaming audio or video from the electronic device.

7. The method of claim **1**, further comprising:

acquiring force data as the touch input is entered through the touch screen, the force data indicating an amount of force applied by one or more fingertips of the user against the touch screen as the touch input was entered;

analyzing the fingerprint data in combination with the timing data and the force data to determine if the touch input was entered with a particular sequence of fingers, with a particular timing sequence, and with a particular amount of force, all of which the user has predetermined to indicate a command to be executed by the electronic device; and

if a predetermined command is indicated by the fingerprint data, the timing data, and the force data, executing the command.

8. The method of claim **7**, wherein the predetermined command indicated by the fingerprint data, the timing data, and the force data is a panic command.

9. The method of claim **1**, wherein the command indicated by the particular sequence of fingers is a macro command that includes a series of commands that when executed together execute the macro command.

10. A mobile communication device, comprising:

a processor, a touch screen communicatively coupled to the processor, the touch screen adapted to receive input through a user contacting or nearly contacting a surface of the touch screen;

a fingerprint sensor communicatively coupled to the processor and to the touch screen, the fingerprint sensor adapted to acquire fingerprint data for one or more fingertips of the user as the user enters touch input through the touch screen; and

a touch processing module stored in a computer readable storage medium, the touch processing module comprising processor-executable code that, when executed by the processor, analyzes the fingerprint data to determine if the touch input was entered with a particular sequence of fingers that the user has predetermined to indicate a command to be executed by the electronic device, wherein if a predetermined command is indicated by the fingerprint data, the processor executes the command, wherein the touch input comprises a sequence of individual touch inputs separated apart in time and the processor: acquires timing data as the touch input is entered through the touch screen, the timing data comprising time intervals between the individual touches; analyzes the fingerprint data in combination with the timing data to determine if the touch input was entered with a particular finger or sequence of fingers and with a particular timing sequence that the user has predetermined to indicate a command to be executed by the electronic device; and if a predetermined command is indicated by the fingerprint data and the timing data, executes the command.

11. The mobile communication device of claim **10**, wherein if a predetermined command is not indicated by the fingerprint data, the processor executes any command that is explicitly indicated by the touch input.

12. The mobile communication device of claim **10**, wherein the touch input conveys an explicit command to be executed by the electronic device, the user has predetermined that the command indicated by the particular sequence of fingers is a stealth command to be executed by the electronic device without any apparent indication that the stealth command is being executed, and the processor executes the explicit command and, while the explicit command is executing, executes the stealth command without outputting an indication that the stealth command is executing.

13. The mobile communication device of claim **12**, wherein the stealth command is a panic command and the processor sends a communication to emergency services as part of executing the panic command.

14. The mobile communication device of claim **13**, wherein the communication to emergency services includes transmitting the geographic location of the electronic device.

15. The mobile communication device of claim **13**, wherein the communication to emergency services includes transmitting streaming audio or video from the electronic device.

16. The mobile communication device of claim 10, wherein the processor:

acquires force data as the touch input is entered through the touch screen, the force data indicating an amount of force applied by one or more fingertips of the user against the touch screen as the touch input was entered;

analyzes the fingerprint data in combination with the timing data and the force data to determine if the touch input was entered with a particular sequence of fingers, with a particular timing sequence, and with a particular amount of force, all of which the user has predetermined to indicate a command to be executed by the electronic device; and

if a predetermined command is indicated by the fingerprint data, the timing data, and the force data, executes the command.

17. The mobile communication device of claim 16, wherein the predetermined command indicated by the fingerprint data, the timing data, and the force data is a panic command.

18. The mobile communication device of claim 10, wherein the command indicated by the particular sequence of fingers is a macro command that includes a series of commands that when executed together execute the macro command.

19. A method of executing a command in an electronic device, comprising:

receiving touch input through a touch screen component of an electronic device;

acquiring fingerprint data from one or more fingertips of the user that are used to enter the touch input through the touch screen;

acquiring force data as the touch input is entered through the touch screen, the force data indicating an amount of force applied by one or more fingertips of the user against the touch screen as the touch input was entered;

analyzing the fingerprint data in combination with the force data to determine if the touch input was entered with a particular sequence of fingers and with a particular amount of force, both of which the user has predetermined to indicate a command to be executed by the electronic device; and

if a predetermined command is indicated by the fingerprint data and the force data, executing the command, wherein the touch input comprises a sequence of individual touch inputs separated apart in time, the method further comprising: acquiring timing data as the touch input is entered through the touch screen, the timing data comprising time intervals between the individual touches; analyzing the fingerprint data in combination with the timing data to determine if the touch input was entered with a particular finger or sequence of fingers and with a particular timing sequence that the user has predetermined to indicate a command to be executed by the electronic device; and if a predetermined command is indicated by the fingerprint data and the timing data, executing the command.

* * * * *